CHAPTER 5

DISCUSSION

5.1 PRELIMINARY STUDY OF DYEING OF POLYPROPYLENE WITH VARIOUS DISPERSE DYES

According to experiment in section 3.4, polypropylene tape yarns were dyed with 7 disperse dyes under various conditions. The four dyes of monoazo type used were C.I. Disperse Orange 3, C.I. Disperse Red 1, C.I. Disperse Orange 5 and C.I. Disperse Brown 1. And the three dyes of anthraquinone type were C.I. Disperse Violet 8,C.I. Disperse Violet 28 and C.I. Disperse Red 60.

The criteria in dye uptake determination are

1. Eye examination of
   1.1 Depth of shade
   1.2 Levelling property
2. Carrier concentration necessary for the dyeing
3. Temperature of dyeing

By preliminary eye examination in depth of shade for each color of dyeing, it is found that azo dyes mostly give pale shades in dyeings while anthraquinone dyes mostly give much deeper shades. A dye from each dye type, i.e. C.I.

Disperse Brown 1 and C.I. Disperse Violet 8, are found to have almost no affinity for polypropylene under all conditions of dyeing. This can be explained that for C.I. Disperse Brown 1, an azo dye which has hydroxyethylaniline derivatives as coupling component, the hydrophillic character of two hydroxyalkyl groups presented in its molecular structure (shown in Appendix 1) leads to no substantivity for more hydrophobic polypropylene fibre in dyeing (17,31). And by molecular weight consideration (Table 5.1), this dye posesses much higher in molecular

Table 5.1 Molecular weights for disperse dyes

DYES	MW
1. C.I. Disperse Orange 3	242
2. C.I. Disperse Red 1	314
3. C.I. Disperse Orange 5	369
4. C.I. Disperse Brown 1	433.50
5. C.I. Disperse Violet 8	283
6. C.I. Disperse Violet 28	307
7. C.I. Disperse Red 60	331

weight than the other three azo dyes, and this may cause some troubles in diffusing inside the polymer structure.In case of C.I. Disperse Violet 8, despite of small molecular size, the physical force or Van de Waal's force which is proportional to molecular weight is too weak to form adequate attraction with polypropylene and hence inadequate depth is appeared on polypropylene.

5.2 THE DETERMINATION OF % DYE UPTAKE AND DYEING PROPERTIES FOR VARIOUS DYES

Due to the undyeability for C.I. Disperse Brown 1 and C.I. Disperse Violet 8 as explained above, their % dye uptakes are thus described as zero for all their dyeings performed and only % dye uptakes for other five dyes are determined.

It is seen that for all conditions of dyeing, ranges of % dye uptakes for azo dyes and antraquinone dyes are different. The dye uptakes for monoazo dyes are in narrow range of variation between 1.511 - 10.059. Dye uptake range for each dye is: 3.296 - 8.386 for C.I. Disperse Orange 3, 2.306 - 7.433 for C.I. Disperse Red 1 and 1.511 - 10.059 for C.I. Disperse Orange 5. While dye uptakes for anthraquinone dyes are considerably different and distributed in broader range than for azo dyes, ranging from 1.324 - 33.928 for C.I. Disperse Violet 28, and 9.686 - 47.197 for C.I. Disperse Red 60, respectively.

It is seen from Figure 5.1 - 5.3 that all these figures are similar in that at low carrier concentration range, the dye uptakes for C.I. Disperse Red 60 are higher than those of the others but at the concentrations higher

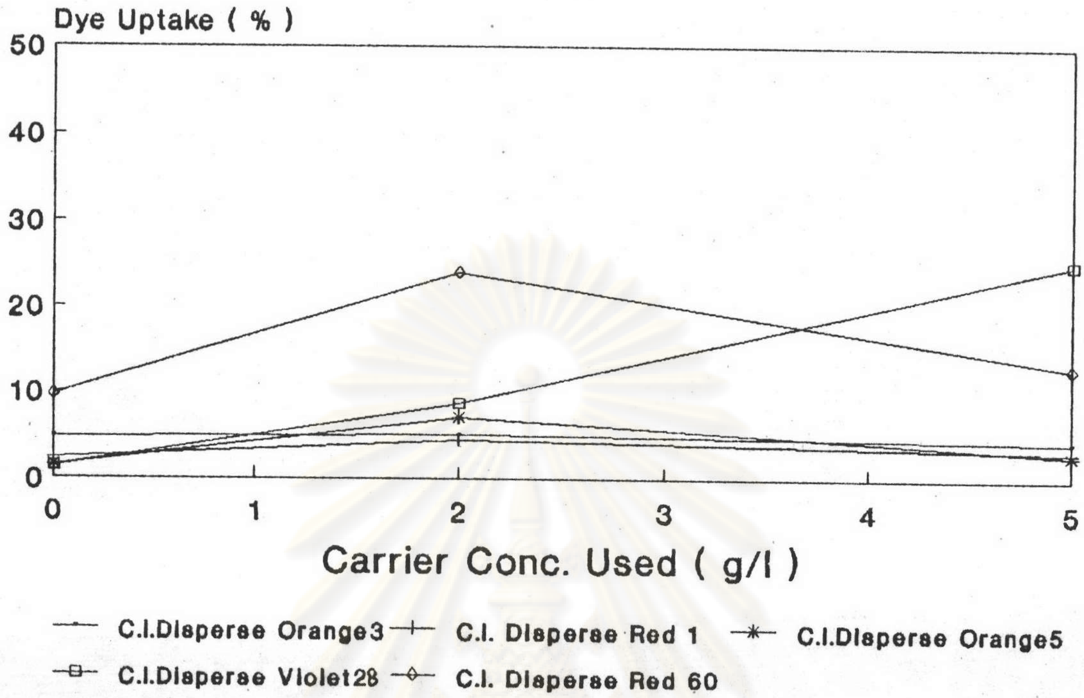


Figure 5.1 Relative dye uptake at 90°C

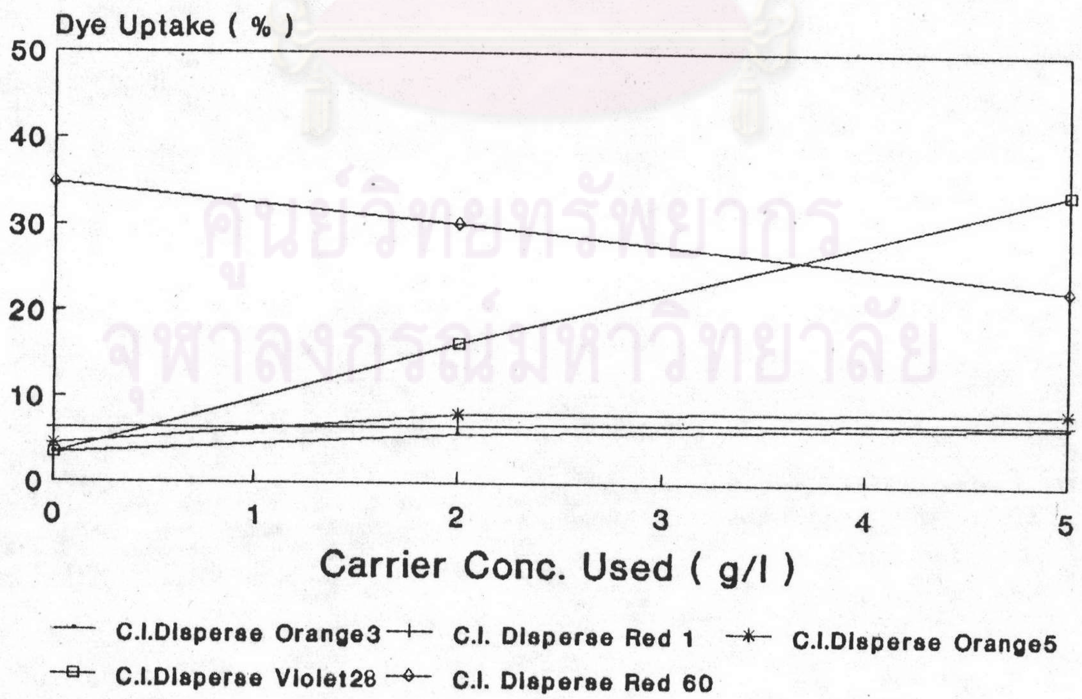


Figure 5.2 Relative dye uptake at 110°C

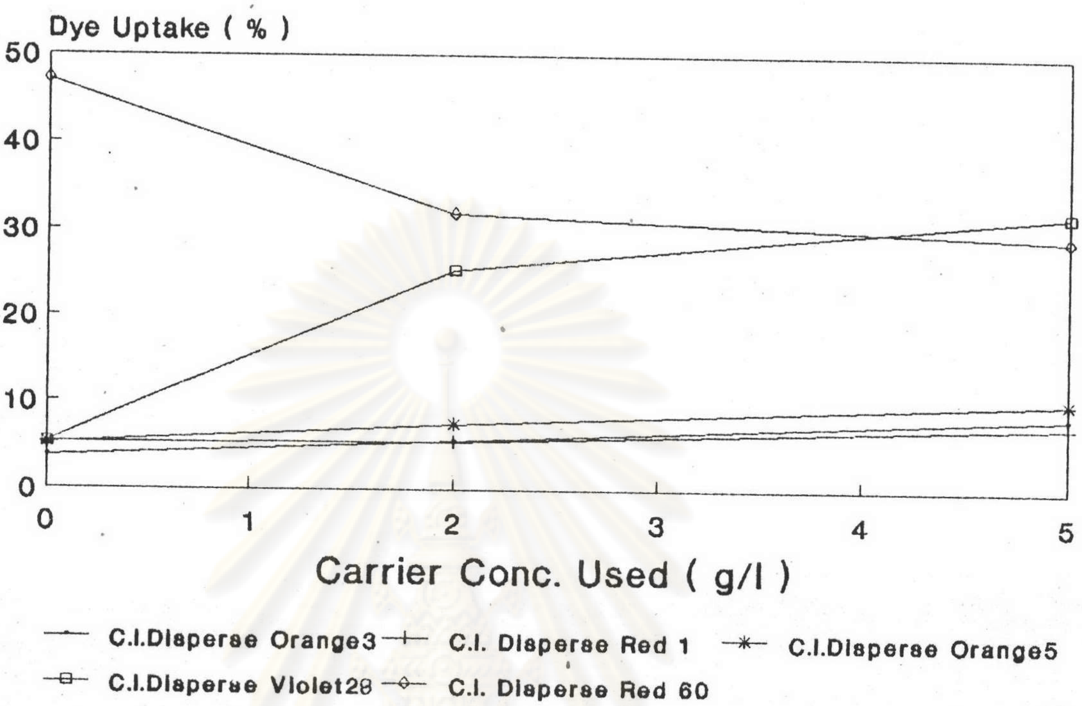


Figure 5.3 Relative dye uptake at 130°C

than 3.5 g/l, the dye uptakes for this dye are lower than those of C.I. Disperse Violet 28 at all temperatures. Thus, it can be said that for C.I. Disperse Red 60 dyeing, the % dye uptakes obtained are high when the concentrations of carrier used are low. As for C.I. Disperse Violet 28, though it gives higher dye uptakes of all in carrier concentration range of more than 3.5 g/l, the high amount of carrier used may result in more carrier remaining in the fibre after the washing process. In addition, the dyeings are unlevel when carrier concentrations are high.

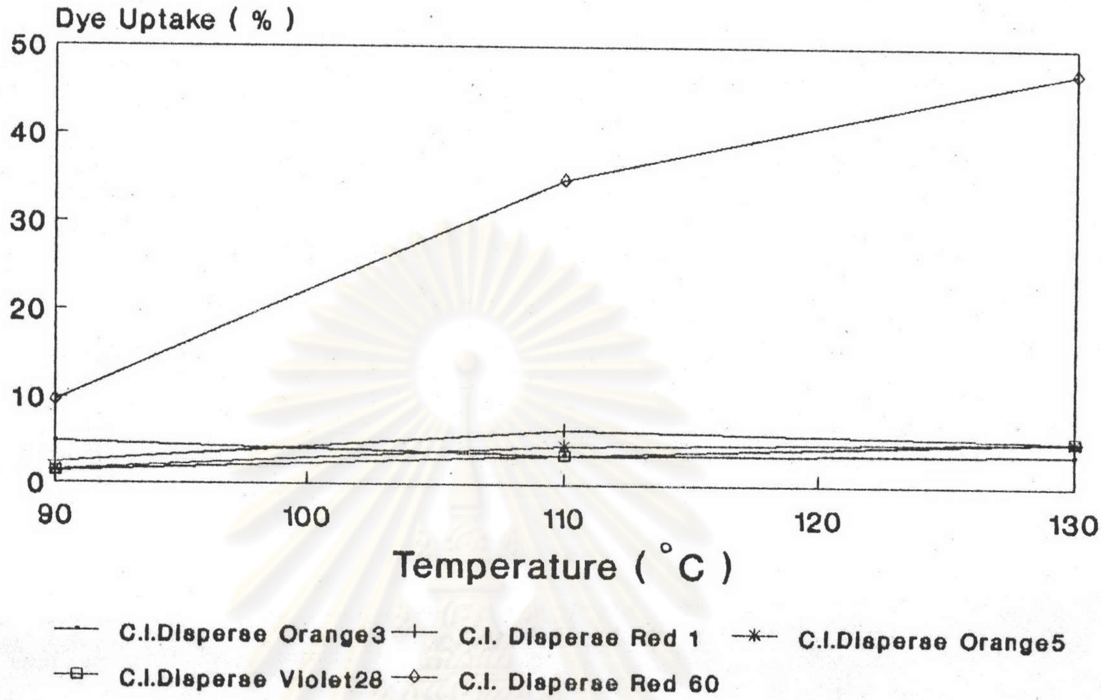


Figure 5.4 Relative dye uptakes without carrier

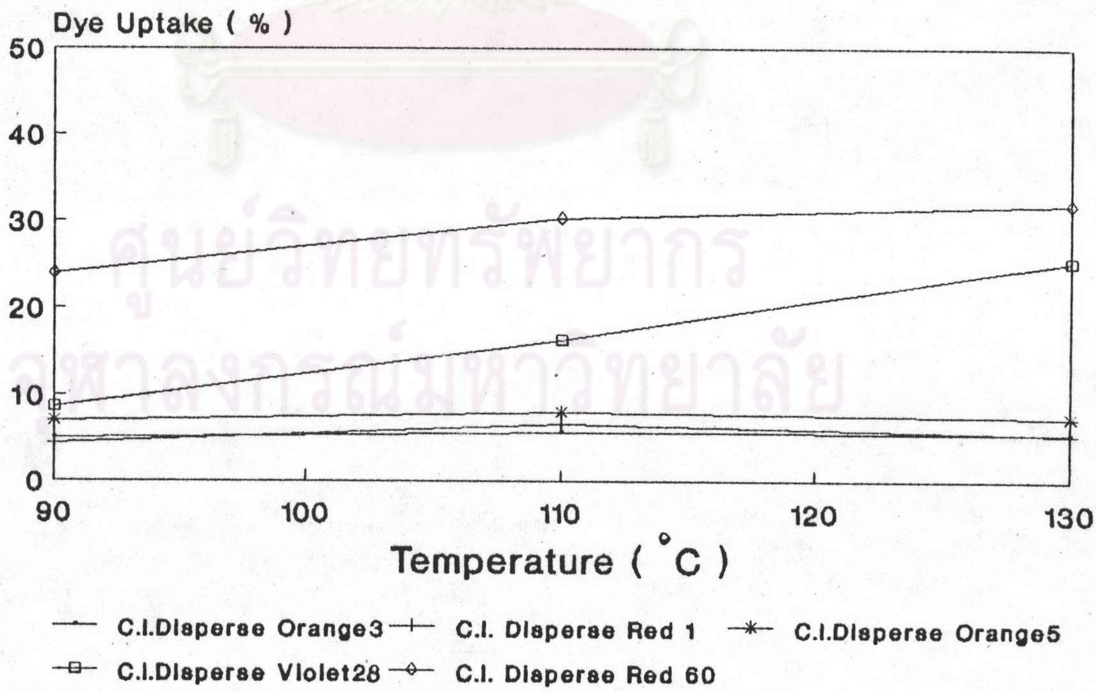


Figure 5.5 Relative dye uptakes at 2 g/l of carrier

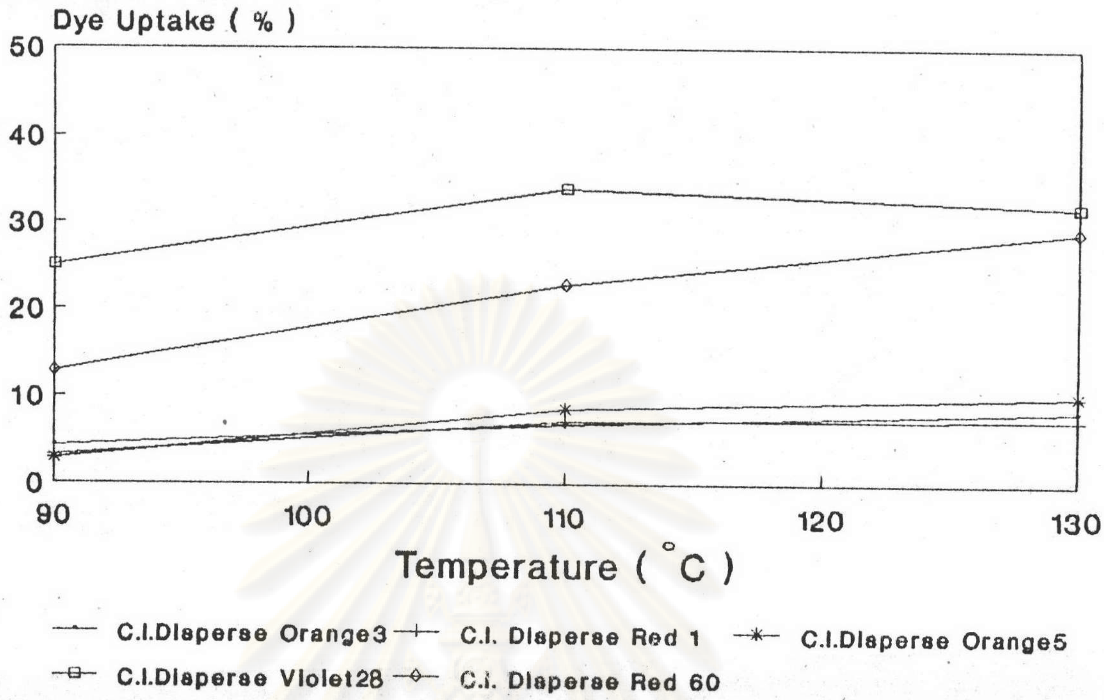
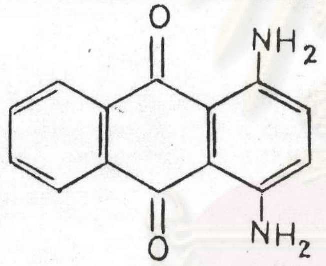


Figure 5.6 Relative dye uptakes at 5 g/l of carrier

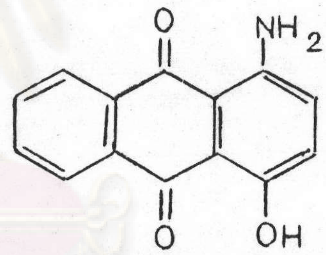
It is seen from Figure 5.4 - 5.6 that at low concentration of carrier (i.e., 2 g/l) or no carrier, C.I. Disperse Red 60 yields highest % dye uptake at all temperatures performed. This stresses again for the findings from Figure 5.1 - 5.3.

It is apparent in Figure 5.1 - 5.6 that there are only two dyes of interest to be considered, i.e., C.I. Disperse Violet 28, and C.I. Disperse Red 60. The three azo dyes have lower dye uptakes due to less affinity comparing with those belong to the anthraquinone dyes. The reason for this may be that all azo dyes are less hydrophobic than anthraquinone dyes used, namely C.I. Disperse Red 1 and C.I. Disperse Orange 5 have hydrophilic hydroxyalkyl groups (i.e., hydroxyethyl, $-CH_2CH_2OH$) and so decrease hydrophobicity which lead to low uptakes; C.I. Disperse Orange 3 has unbalanced hydrophobic characters (17) between amino group (electron donating group) and nitro group (electron withdrawing group) and so decrease the suitability for polypropylene dyeing.

Considering the two anthraquinone dyes with more affinity than azo dyes, the red one is considered more suitable for polypropylene dyeing than the violet one. In general, anthraquinone dye with relative simple molecule, e.g. 1,4-diaminoanthraquinone (C.I. Disperse Violet 1) and C.I. Disperse Red 15 are found to possess adequate



C.I. Disperse Violet 1



C.I. Disperse Red 15

affinity for cellulose acetate, but no or little affinity for polyester and polypropylene (17,31). But suitable derivatives for these hydrophobic fibres can be obtained by adding more hydrophobic substituents to the dye structure, e.g. two chloride groups as in the case of violet dye and $-OC_6H_5$ group as in red dye. These substituents help to promote hydrophobic character and give better results of dyeings. The $-OC_6H_5$ group is found to exhibit more hydrophobicity than the two chloride groups of the violet dye. Though the dyeings with violet dye when using carrier of 5 g/l, give better dye uptakes than red dye, but levelling property of the final dyeings are poor. Also, the dye uptakes of violet dye in the presence of 5 g/l of carrier are not significantly different from red one dyed without carrier. Dyeing without any carrier, while maintain the same result as dyeing with some carrier, will provide for some convenience, low cost and reduction of some adverse effects on light fastness coming from using too much concentration of carrier.

5.3 STUDY OF EFFECTS OF CARRIER CONCENTRATION AND TEMPERATURE ON THE DYEING OF POLYPROPYLENE WITH C.I. DISPERSE RED 60

By using the data from Table 4.4(A) - 4.4(G) for graph plotting, two graphs are created for the purpose of studying the effects of carrier concentration and temperature as shown in Figure 5.7 and Figure 5.8.

It is seen from Figure 5.7 that at all temperatures of experiment, % dye uptakes are inversely proportional to the carrier concentrations used beyond 1 g/l of using. The dye uptake is increased as the carrier concentration increases from 0 g/l to 1 g/l.

From Figure 5.8, it is shown that as the temperature is increased, the % dye uptake is increased too. And at the temperatures of 120 and 130 °C, best results are obtained when no carrier is added to the dyebath during dyeing period.

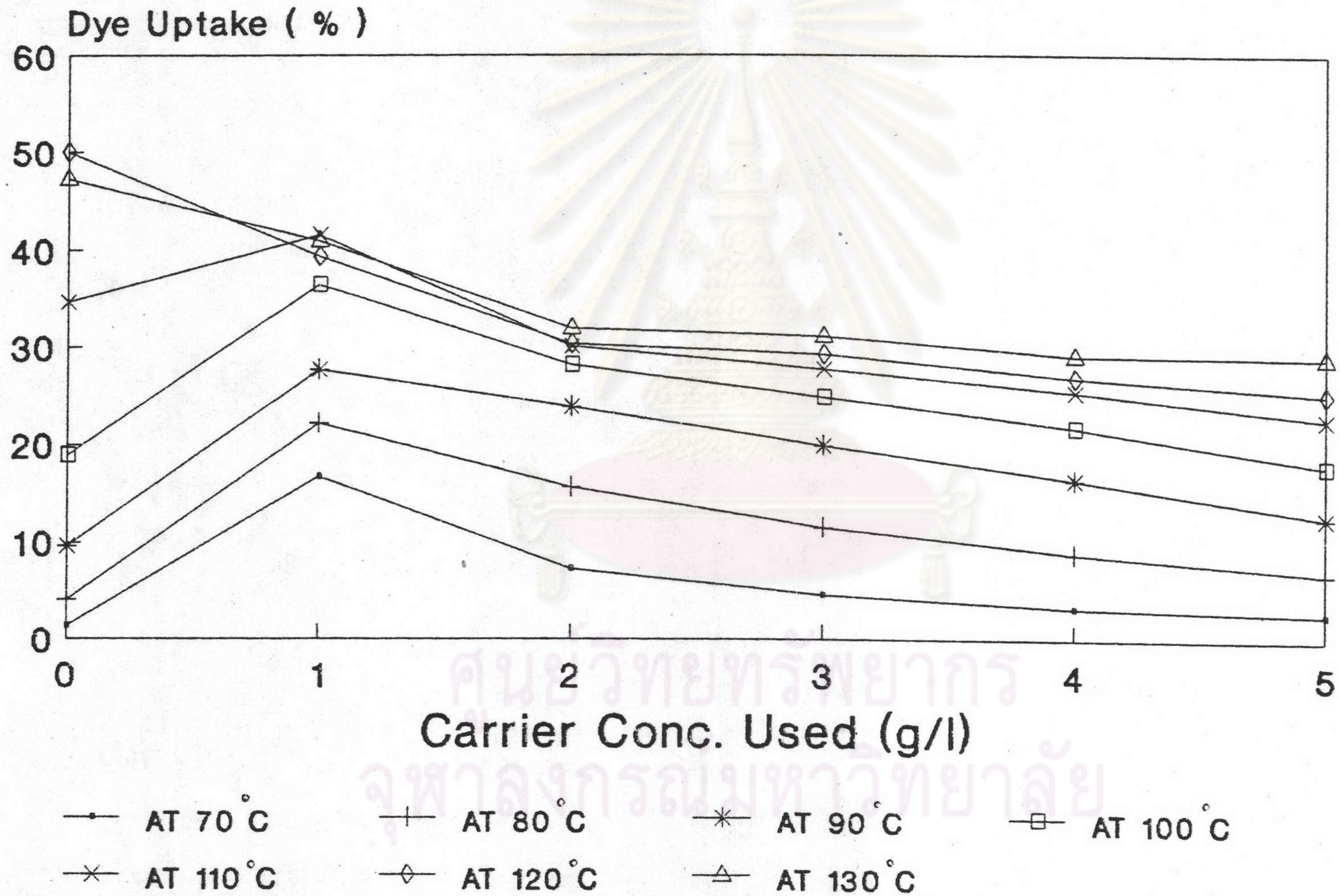


Figure 5.7 Effect of carrier concentration used on % dye uptake

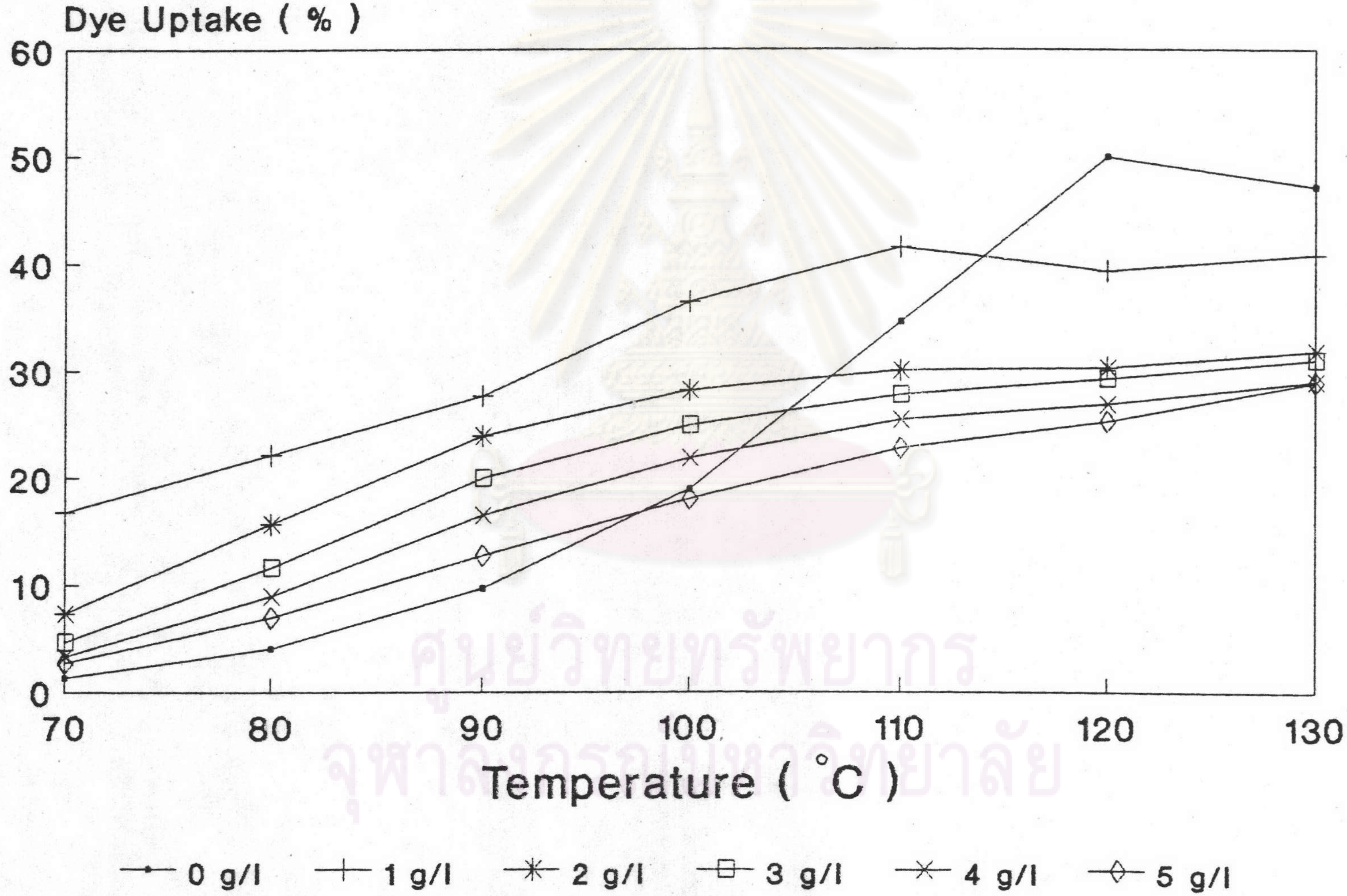


Figure 5.8 Effect of temperatures on % dye uptake

5.4 ASSESSMENT OF LIGHT FASTNESS (24)

The final light fastness assessment in numerical ratings is based on contrast (change in color) equal to grey scale grade 2 between exposed and unexposed portions of the specimen. The light fastness assessment is graded in 1-8 range as follows:

Grade 8	Maximum fastness
Grade 7	Excellent fastness
Grade 6	Very good fastness
Grade 5	Good fastness
Grade 4	Fair fastness
Grade 3	Moderate fastness
Grade 2	Slight fastness
Grade 1	Poor fastness

From the experiment in section 3.10, the light fastness of specimen, dyed with C.I. Disperse Red 60 at 120 °C without carrier and possessing the highest % dye uptake on it after dyeing, is 3-4 which is described as moderate fastness to fair fastness.